

First documentation of thirteen nudibranch species on Cambodian coral reefs

Running head: Presence of nudibranchs in the Koh Rong Archipelago

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Introduction

Nudibranch, meaning ‘naked gills’, is an order of shell-less mollusc (Class: Gastropoda; Sub-class: Opisthobranchia; Order: Nudibranchia). Over 2000 species of nudibranchs have been described worldwide (Behrens, 2005), the majority of which are found on Asia-Pacific reefs (Debelius, 2001). Numerous texts have documented the distribution of many of these species; however, as with a multitude of other marine organisms in Cambodia, there is a distinct paucity in data on nudibranch distribution. There are no specific publications relating to opisthobranch research in Cambodia and the most recent, notable, journal publication relating to opisthobranchs in the South China Sea was carried out by Sachidhanandam *et al.* (2000). In their study Sachidhanandam *et al.* (2000) note that all of their nudibranch data from Cambodia was sourced from older studies. Many species common in other areas of the Indo-Pacific have not been recognised in Cambodia; therefore, this study records thirteen species that were previously undocumented on Cambodian coral reefs.

Nudibranchs have very few natural predators. Many species prey on porifera (marine sponges), which usually contain toxic compounds. Over time, these toxins accumulate in their tissues making them less palatable to prospective predators (Faulkner & Ireland, 1977; Cimino *et al.*, 1999). Linked with this is an antipredator adaptation, aposematism, apparent in many species of nudibranchs (Gosliner & Behrens, 1990; Tullrot, 1998). This is such a strong characteristic that other, non-toxic, species have similar colouration and are examples of Batesian mimicry (Ruppert & Barnes, 1994). These characteristics may be an important factor determining their geographical distribution, as porifera phylogeny and prospective predator recruitment are likely to vary across a region.

Populations of nudibranchs are scarce and transient (Todd, 1981; Marshall & Willan, 1999), and thus carrying out formulaic research, i.e. using quadrats and transects, is near impossible.

In addition to this, it is difficult to determine how benthic structure will affect population distribution. As such, the nudibranchs found in this study were photographed idiosyncratically at undetermined locations around the Koh Rong Archipelago, Cambodia (Fig. 1).

Newly documented species

Genus and species: *Hypselodoris tryoni* (Garrett, 1873)

Family: Chromodorididae

Description:

Identifiable by a tall body profile with a protruding mantle, *Hypselodoris tryoni* is usually found on rocky substrates (Fig. 2). They are tan in colour with black, blue or red spots. Their known distribution ranges from Tanzania, through Indonesia to Japan (Debelius, 2001). This is the first record of them in Cambodia.

Genus and species: *Pteraeolidia ianthina* (Angas, 1864)

Family: Facelinidae

Description:

Distributed from Mauritius, East Africa, Arabia to Australia, Japan and Hawaii, this wide ranging nudibranch is often seen in southeast Asia (Debelius, 2001). *Pteraeolidia ianthina* grows to a length of 15 cm (Fig. 3). The Global Biodiversity Information Facility (GBIF, 2014) notes 187 records of this species, but none in Cambodia. In the South China Sea this species has been recorded in China, Singapore and Vietnam (Sachidanandam *et al.*, 2000)

Genus and species: *Goniobranchus fidelis* (Kelaart, 1858)

Family: Chromodorididae

Description:

This colourful red and white nudibranch grows to a length of 4 cm (Fig. 4). Their distribution is known to extend from the Red Sea across to the Marshall Islands (Debelius, 2001).

Genus and species: ***Cuthona yamasui* (Hamatani, 1993)**

Family: Teripediidae

Description:

Distributed across tropical Indo-West Pacific, *Cuthona yamasui* (Fig. 5) has variable colouration. The head, rhinophores and cerata are found across the colour spectrum (Hamatani, 1993). It has long rhinophores and distinguishable cerata. This species has not been noted in Cambodia previously.

Genus and species: ***Doriprismatica atromarginata* (Cuvier, 1804)**

Family: Chromodorididae

Description:

Distributed from South Africa, through the Red Sea and across to Japan, this distinctive nudibranch is fairly common (Fig. 6). It grows to a maximum length of 9 cm. GBIF (2014) noted 143 documentations of *Doriprismatica atromarginata* worldwide. Sachidanandam *et al.* (2000) recorded the species in Hong Kong, Thailand, Vietnam, Singapore, Malaysia and China, but not Cambodia.

Genus and species: ***Phyllidia tula* (Marcus and Marcus, 1970)**

Family: Phyllidiidae

Description:

Noted across Micronesia, this spotty species of nudibranch is relatively common (Debelius, 2001). They grow to a length of 8 cm (Fig. 7). Sachidanandam *et al.* (2000) did not record *Phyllidia tula* anywhere across the South China Sea.

Genus and species: ***Phyllodesmium magnum* (Rudman, 1991)**

Family: Facelinidae

Description:

This large species of nudibranch can grow to 13 cm in length (Fig. 8). They feed on coral tissue and are distributed through the Red Sea, Australia and the Marshall Islands. GBIF (2014) noted 10 records of *Phyllodesmium magnum* worldwide, but none from Cambodia. This species has unique cerata which grow as lunar-shaped appendages.

Genus and species: ***Glossodoris cincta* (Bergh, 1888)**

Family: Chromodorididae

Description:

N.B. Personal observation (B.Thorne, 2013) – no figure available.

This species is known for having three colour forms (Debelius, 2001). The individual noted in this study was pale cream on the upper mantle and brown on the side mantle with a dark green mantle margin. This particular phylogen had been documented from the Maldives to North Australia (Debelius, 2001). GBIF (2014) have recorded 64 incidences of this species, but none from Cambodia.

Genus and species: ***Chromodoris leopardus* (Rudman, 1987)**

Family: Chromodorididae

Description:

This striking but common species of nudibranch (Fig. 9) is generally found in sheltered habitats (Debelius, 2001). Its known distribution range is from East Australia to the Philippines; however, we now note its presence further north into Cambodia. Sachidanandam *et al.* (2000) did not record *Chromodoris leopardus* anywhere across the South China Sea.

Genus and species: ***Flabellina rubrolineata* (O'Donoghue, 1929)**

Family: Flabellinidae

Description:

N.B. Personal observation (B.Thorne, 2013) – no figure available.

This noticeable nudibranch has deep purple colouration and long, conspicuous cerata. It can grow to a length of 4 cm. It is commonly found on the hydroid *Halocordyle disticha*, which is its favoured food source (Debelius, 2001). It is found throughout the Indo-Pacific, yet this is the first documented presence in Cambodia.

Genus and species: ***Cadlinella ornatissima* (Risbec, 1928)**

Family: Chromodorididae

Description:

N.B. Personal observation (B.Thorne, 2013) – no figure available.

This small species of nudibranch grows to a maximum length of 2 cm. It favours strong currents and tidal channels (Debelius, 2001). Yellow or white in colouration, the noticeable characteristic is rich pink tips to their cerata. Sachidanandam *et al.* (2000) recorded this species in Hong Kong and Singapore, but not Cambodia. GBIF (2014) have 25 records of this species, again with none in Cambodia.

Genus and species: ***Hypselodoris krakatoa* (Gosliner & Johnson, 1999)**

Family: Chromodorididae

Description:

Found across the Eastern Pacific from Japan to Papua New Guinea, *Hypselodoris krakatoa* (Fig. 10) can grow to a length of 5.5 cm (Gosliner & Johnson, 1999). GBIF (2014) have 9 records of this species, with none in Cambodia.

Genus and species: ***Ceratosoma trilobatum* (Gray, 1827)**

Family: Chromodorididae

Description:

This large nudibranch can grow to 10 cm in length (Debelius, 2001). It is variable in colouration, but easily identifiable by large wing-like processes on either side of the gills (Fig. 11) (Debelius, 2001). Located from the Red Sea, through Indonesia to Australia, this species is not uncommon.

Conclusion

The nudibranchs described in this study are just a few species that are found in Cambodian waters throughout a single archipelago. In addition to these newly documented species, there are many more yet to be noted along the Cambodian coastline. Further research will undoubtedly uncover more.

Acknowledgements

We would like to thank the staff and volunteers of Coral Cay Conservation who accompanied us on many of the identifying dives. We'd also like to thank and acknowledge the photographers whose images have assisted with the identification. Photographs have been

individually credited. We would also like to thank the Blue Moon Fund and the Darwin Initiative who actively resource the research of Coral Cay Conservation in Cambodia, and finally, the Royal Government of Cambodia's Fisheries Administration for allowing us to carry out research in their coastal waters.

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Figures

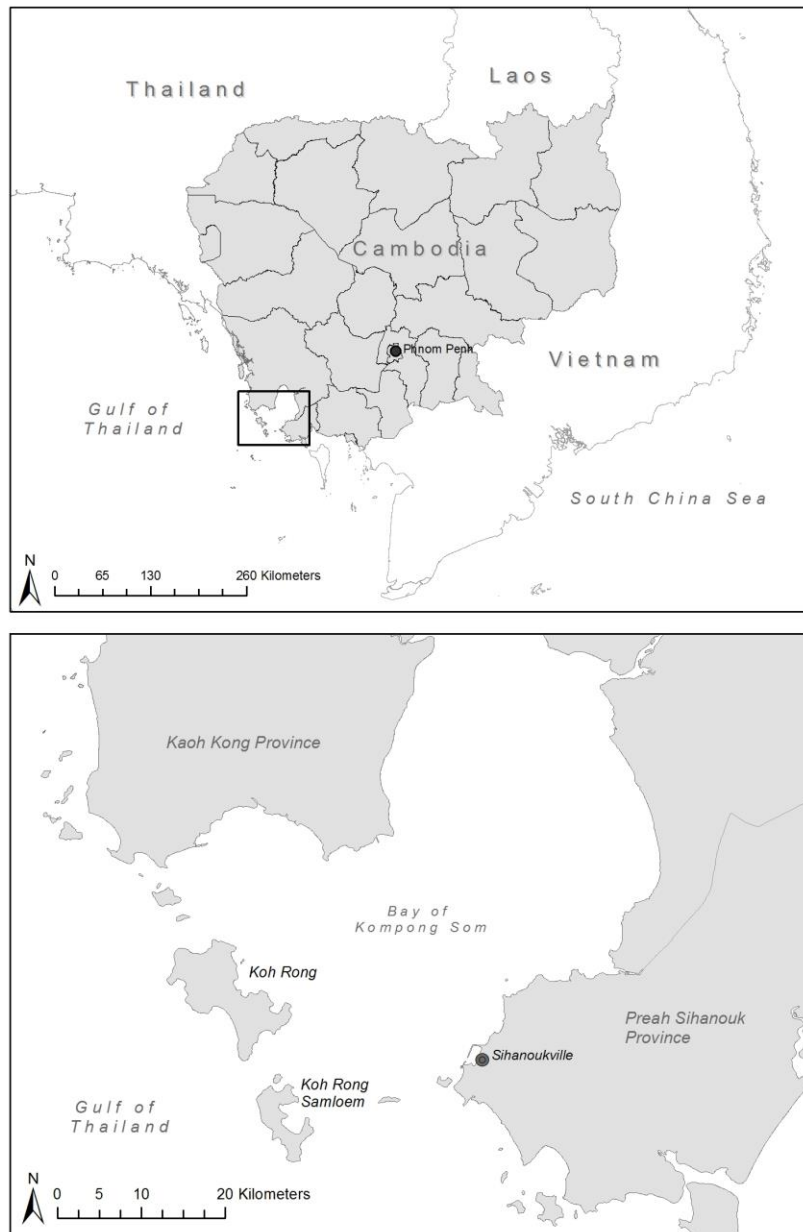


Figure 1 – Map of the Koh Rong Archipelago, Cambodia.



Figure 2 – *Hypselodoris tryoni* located on an algal dominated rocky substrate. Credit: B.V.

Thorne



Figure 3 – *Pteraeolidia ianthina* located on the top of a large coral bommie. It was found in strong currents. Credit: B.V. Thorne



Figure 4 – *Goniobranchus fidelis* on an algal dominated substrate. Five individuals are present. Credit: F. Langran-Goldsmith



Figure 5 – *Cuthona yamasui* in shallow water on a sandy substrate. Credit: J. Slater



Figure 6 – *Doriprismatica atromarginata* residing on a barrel sponge. Credit: F. Langran-Goldsmith



Figure 7 – *Phyllidia tula* on a large rocky outcrop. Credit: F. Langran-Goldsmith



Figure 8 – *Phyllodesmium magnum* eating soft coral. Credit: F. Langran-Goldsmith



Figure 9 – *Chromodoris leopardus* on crustose coralline algae, *Lithothamnium*. Credit: B.V.

Thorne



Figure 10 – *Hypselodoris krakatoa* on an algal based rocky substrate. Credit: F. Langran-Goldsmith



Figure 11 – *Ceratosoma trilobatum* on an algal substrate. This habitat was also very silty.

Credit: K. Gavard